PART SPECIFICATION

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THERMAL SENSORS
PLATINUM RESISTANCE TYPE
GENERAL SPECIFICATION FOR

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B	JVR	648	Standard	*	06-17-85	JWM	514
C	JWA	648	Standard	All	04-09-92	RLH	514
D	JWA	648	Standard	All	07-29-92	RLH	514
E	JWA	648	Standard	*	08-25-92	RLH	514
F				All	10-30-92	RLH	514

* Denotes change from prior release.

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LIST

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1. SCOPE

1.1 Content This document describes the general manufacturing and testing requirements for platinum resistance type temperature sensors. The requirements provide a level of quality and reliability assurance for the acquisition of temperature sensors to be used for extended flight in space on JPL Mission Class A and B applications.

1.2 Device type. The characteristics and/or requirements unique to each device type shall be as specified in the individual ST/PT, drawing hereinafter referred to as the detail drawing.

1.2.1 Configuration outline. The configuration outline shall be as designated in the detail drawing.

1.2.2 Part number. The part number shall be marked in accordance with the JPL detail specification.

2. APPLICABLE DOCUMENTS

2.1 Applicable documents. The following documents, of the issue in effect on the date of invitation for bids or request for proposal form a part of this specification to the extent specified herein.

SPECIFICATIONS

Military

MIL-R-39032 Resistors Packaging of

STANDARDS

MIL-STD-202 Test Methods for Electronic and Electrical Component Parts

MIL-STD-1285 Marking of Electrical Parts.

National Institute of Standards and Technology (NIST)

IPTS 68 International Practical Temperature Scale

2.2 Precedence. In the event of conflict between the text of this document and the documents referenced herein, the text of this document shall take precedence.

2.3 Terms and definitions.

2.3.1 Control unit. A control unit is a device identical to the test specimens and from the same lot. It is not subjected to any of the stresses applied to the test specimens and is used to verify the resolution, accuracy and repeatability of the measurement equipment. Reference measurements using the control units shall be read

and recorded before and after each measurement operation on the lot. Use of secondary standards is acceptable.

2.3.2 Trace number. The trace number is the number assigned by the procurement document to link a part number to a specific purchase order or Order Release.

2.3.3 Screening. Screening consists of the tests performed on 100 percent of the devices to be shipped against the order.

2.3.4 Calibration resistance. The dc resistance value of a device at a specified temperature with zero electrical power dissipated.

2.3.5 Standard reference temperature. The standard reference temperature is the temperature of the device body at which nominal zero-power resistance is specified.

2.3.6 Resistance - temperature characteristics. The resistance - temperature characteristics is the zero-power resistance measured at specified reference temperatures.

2.3.7 Operating temperature range. The operating temperature range is the specified temperature range over which the device shall be capable of operating.

2.3.8 Dissipation constant. The dissipation constant is the amount of I^2R power required to selfheat the device 1°C.

2.3.9 Thermal time constant. The thermal time constant is the time required for a device to change 63.2% of the difference between its initial and final body temperatures, when subjected to a step function change in temperature under zero-power conditions.

2.3.10 Interchangeability. Interchangeability is the measure of how closely the output of a device matches that of a master table.

3. REQUIREMENTS

3.1 General requirements. The temperature sensors described in this document shall meet the requirements specified herein and the requirements specified in the applicable JPL detail specification. In the event of conflict, the order of precedence shall be the JPL detail specification, this specification, then MIL-STD-202. Any conflict noted shall be brought to the attention of the JPL cognizant component engineer.

3.1.1 Traceability. Complete traceability shall be maintained for each part serial number to lot date code and/or manufacturer lot number and to the trace number, if assigned.

3.1.2 Certificate of conformance. A certificate of conformance to this specification, signed by an authorized representative of the manufacturer, must accompany each shipment.

3.1.3 Lot numbering. A lot number shall be assigned to each group of parts manufactured and tested to the requirements of this specification.

3.1.4 Serialization. Each device shall be identified by an individual serial number prior to the first test or inspection. The test agency shall be responsible for serialization unless the part is already properly serialized.
The following requirements shall apply:

a) The original serial number shall not be changed unless the label or marking becomes misplaced or defaced during testing, in which case a new serial number shall be installed on the part. The replacement number and the original number shall be cross referenced on a pertinent events sheet.

b) The serial numbers shall not be duplicated for the same part type. Serial numbers may be in the form of either labels or stamping and shall be installed in such a manner as to avoid covering vital part marking information.

c) Serial number labels installed on leads shall be located at least 0.5 inches from the device body. For devices too small to be labeled, the part shall be kept in individual JPL-approved bags with serial numbers attached to the bags.

d) As an option to c) above, serial numbers will be applied to the sensor body with a ceramic glaze. A paper label containing the serial number will also be visible in a plastic box with each individually packaged sensor.

3.1.5 Labels. The adhesive labels used for serialization noted in 3.1.4, c) unless otherwise specified, shall be selected from the following list (no special preference is intended):

a) Avery-Heatex.

b) W.H. Brady B953 HT200

3.1.6 Part marking. The devices shall be permanently and legibly marked by the manufacturer. All markings shall meet the requirements of MIL-STD-1285, Method I. Part marking shall consist of the model number, manufacturers name or logo, date code, resistance at 0°C, serial number and JPL part number. If part marking cannot be placed on the device due to size, a label/tag shall be supplied in the container of each individual sensor with the above information as a minimum.

ST/PT SPECIFICATION NUMBERING SYSTEM

ST11784	M	W	R	A	5000	F
BASIC DWG. No.	**PART TYPE**	**ELEMENT**	**CONFIGURATION**	**CHARAC/CALIB.**	**RESISTANCE**	**TOLERANCE %**
	R=RESISTOR	C=CARB.COMP.	A=AXIAL	**-PART TYPE R-**	(See note)	V=0.005
	M=SENSORS &	F=CARB.FILM	B=BEAD	Y= 10 PPM		T=0.01
	THERMISTORS	M=METAL FILM	C=CHIP	E= 25 PPM		Q=0.02
		W=WIRE	D=DIP	H= 50 PPM		A=0.05
		S=SPECIAL	F=FLAT PACK	K=100 PPM		B=0.1
			H=HYBRID PACK	M=300 PPM		D=0.5
			R=RADIAL	S=SPECIAL		F=1
			S=SPECIAL	**-PART TYPE M-**		G=2
				A=-180 to 500°C		J=5
				B=-260 to 0°C		K=10
				C=-260 to 500°C		S=SPECIAL
				D= 0 to 200°C		
				E= 0 to 500°C		
				F= 0 to 800°C		
				G= 0 to 660°C		
				K= 19.8 %		
				L= 29.4 %		
				M= 48.7 %		
				N= 0.5 %		
				S=SPECIAL		

NOTE: Four character resistance designation. The four character resistance designation is applicable to all resistance tolerances. The nominal resistance is identified by four digits; the first three digits represent significant figures and the last digit specifies the number of zeros to follow. When the value of resistance is less than 100 ohms, or when fractional values of an ohm are required, the letter "R" shall be substituted for one of the significant digits to represent the decimal point. When the letter "R" is used, succeeding digits of the group represent significant figures. The resistance value designations are shown below. The resistance may be any value within the minimum and maximum resistance values specified in the detail drawing.

If size does not permit the ST in the part number may be omitted.

Designation of resistance values

Designation	Resistance
1R00 to 9R88 inclusive	1.00 to 9.88 inclusive
10R0 to 98R8 inclusive	10.0 to 98.8 inclusive

1000 to 9880 inclusive	100	to	988	inclusive
1001 to 9881 inclusive	1,000	to	9,880	inclusive
1002 to 9882 inclusive	10,000	to	98,800	inclusive
1003 to 9883 inclusive	100,000	to	988,000	inclusive
1004 to 9884 inclusive	1,000,000	to	9,880,000	inclusive

3.2 Individual detail drawing. The requirements unique to each device type shall be as specified in the individual ST/PT drawing.

3.3 Item requirements. The individual item requirements shall be as specified herein and in the detail drawing.

3.4 Design, construction and physical dimensions. The design, construction, and physical dimensions shall be as specified in the detail drawing and herein. The manufacturer shall notify JPL of any changes in product design.

3.4.1 Visual/dimensional inspection. Workmanship shall be consistent with good manufacturing practices and designed to achieve optimum reliability. All parts shall meet the visual criteria defined in the detail specification.

3.4.2 Lead configuration. The lead configuration shall be as specified in the detail specification.

3.4.3 Operating temperature range. The operating temperature range shall be as defined in the detail specification.

3.4.4 Interchangeability. The interchangeability requirements shall be as defined in the detail specification.

3.4.5 Resistance temperature characteristics. The devices shall be calibrated in accordance with paragraph 4.5.4 and Table II. Unless otherwise specified in the applicable detail specification Schedule A shall apply.

3.5 Qualification inspection. Qualification inspection is not required unless defined in the purchase document.

3.6 Screening inspection. The contractor is responsible for the performance of screening inspection as defined in this document. The screening tests shall be performed on 100 percent of the parts in each lot. Testing shall be in the sequence and to the requirements specified in Table I.

3.6.1 Control units for measurement. A control unit shall be used to check the resolution,accuracy and repeatability of the measurement equipment. Its value shall be as close as practicable to that of the devices being tested. Use of a secondary standard is acceptable. The control unit shall not be subjected to any tests, but it shall be measured prior to and after measuring the test samples and its reading compared to the previous reading.

3.6.2 Visual examination. All the devices shall be visually examined as specified in paragraph 4.5.1. Dimensional inspection shall be to the dimensions specified in

the detail drawing. Devices out of dimensional tolerance or showing visual defects shall be rejected.

3.6.3 0°C calibration resistance. When the devices are tested as specified in paragraph 4.5.2. devices exceeding a resistance tolerance of ±1% at 0°C shall be rejected. The following details shall apply:

a) The DC resistance measurement shall be made at 0 ±0.003°C.

b) Bridge measurement accuracy shall be ±(0.015 percent + 0.02 ohm).

c) Measurements shall be recorded to five significant figures specified in the detail specification.

d) Care shall be exercised during the measurement to avoid self heating of the device.

3.6.4 Thermal shock. When the devices are tested as specified in paragraph 4.5.3. there shall be no evidence of mechanical damage, and the change shall not exceed ± 0.1°C (± 0.04 percent +0.01 ohms). The following details shall apply:

a) Measurement before test: 0°C calibration resistance of each device shall be measured as specified in paragraph 3.6.3.

b) Number of cycles: Ten cycles, with a minimum dwell time of 5 minutes at each temperature extreme.

c) Measurement after test: 0°C calibration resistance of each device shall be measured and the change in resistance shall be calculated.

d) Examination after test: The devices shall be examined in accordance with paragraph 3.6.2.

3.6.5 Insulation resistance. When tested as specified in 4.5.5 the insulation resistance shall be 100 megohms minimum.

3.6.6 Burn-in. When tested as specified in 4.5.6 the delta Ro shall not exceed 0.1 percent and there shall be no visible mechanical damage as a result of the test.

4. QUALITY AND RELIABILITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein.

4.2 Test surveillance. The designated JPL Technical Representative or his alternates shall have immediate access to the testing area at any time during the test agency's normal working day. Additionally, as part of the surveillance function, the JPL Technical Representative shall have the prerogative of observing

any test or reviewing data for any tests performed as a requirement of this specification.

4.2.1 Technical representative. The test agency shall designate a member of its engineering organization as Technical Representative to JPL.

4.3 Inspection plan. The manufacturer shall maintain an effective and economical testing plan covering the requirements specified herein. The manufacturer shall prepare a screening and demonstration test procedure for JPL approval, to assure that the parts tested meet these requirements. The approved procedure shall contain, as a minimum, the following:

a) Title page, procedure number, part number and the latest revision letter.

b) Reference, test equipment involved, serial numbers, and resolution and accuracies.

c) Sequence of measurements, symbols and units of measurements, and setup of equipment and procedure.

d) Sequence of applied stress including chamber and instrument operating conditions and checking sequences.

e) Provisions for monitoring test progress and for supplying component failure status to JPL after each measurement point.

f) Provisions for, and explanation of data gathering and data submittal.

g) Procedures for component handling and packaging.

h) Necessary special handling precautions to prevent damage or contamination of the parts or the markings.

i) Any other applicable provisions or procedures.

4.4 Test equipment calibration. The testing agency shall have available the necessary measuring equipment. The equipment shall be capable of performing tests and measurements in accordance with accuracy requirements of this specification and the detail drawing. The testing agency shall establish and maintain a program for calibration, control and maintenance of measurement and test equipment. The program shall include:

a) Provision for calibration of measurement equipment and environmental equipment at scheduled intervals against standards traceable to those maintained by the National Institute of Standards and Technology.

b) Requirements for signed and dated records of calibration which shall be made available to JPL upon request.

c) Provision for displaying on the individual equipment the last calibration date and the next calibration due date.

4.5 Methods of examinations and tests. Examinations and test shall be performed in accordance with MIL-STD-202, and as specified herein or by procedures approved by JPL.

4.5.1 Visual examination. All devices shall be visually examined under 15X, minimum magnification. Workmanship shall be consistent with good manufacturing practices, designed to achieve optimum reliability. The devices shall meet the dimensional criteria defined in the detailed drawing.

4.5.2 0°C calibration resistance. This calibration point is taken using a well stirred ice bath. The sensor will be immersed in the bath and allowed to come to equilibrium. Under these conditions the resistance of the sensor will be read to within ±0.015% and recorded. Precautions will be taken to maintain the ice-bath temperature at 0°C ±0.003°C. The procedure for calibrating at 0°C shall be as follows:

a) Set up the ice bath apparatus as shown in Figure 1.

b) Attach temporary calibration leads to the sensor.

c) Insert the sensor into a waterproof bag.

d) Put sensor in ice bath and allow to come to equilibrium (approximately 5 minutes).

e) Connect the lead wires of the sensor to the Resistance Bridge.

f) Measure and record the resistance value of the sensor.

g) Disconnect the sensor from the Resistance Bridge.

h) Measure the resistance of the temporary calibration leads.

i) Subtract the lead resistance from the reading taken in step f), also make the bridge error correction and record.

4.5.3 Thermal shock. Each sensor shall be Thermally Shocked as follows:

a) Prepare two temperature baths. One shall be LN_2 and one shall be Dow Corning #200 Silicone fluid at 105 ±5°C.

1/ b) Place sensor in the LN_2 bath for 5 minutes minimum.

1/ c) Remove sensor from the LN_2 bath and quickly immerse sensor in the 105 ±5°C silicone fluid bath for 5 minutes minimum.

d) Repeat steps b) and c) nine more times for a total of 10 cycles.

1/ Sensors that are not sealed units shall be placed in a metal tube prior to immersion in the fluid.

4.5.4 Resistance temperature characteristics. The resistance temperature characteristics shall be calculated using the calibration points specified in Table III and the IPTS-68 equation. A secondary standard shall be used(except for LHe, and Ice point calibrations). It shall be a precision platinum resistance thermometer bearing NIST certification. The procedure for calibrating at these temperatures shall be as follows:

a) Attach temporary calibration leads to the sensor.

1/ b) Insert sensor into metal tube for protection from fluid.

c) Set up the temperature bath as in Figure 2. During the set-up for these calibrations, it is important that the sensing element of the standard (except LHe, and Ice point calibrations) should be located as close as practical to the sensing element of the sensor and at the same depth as the sensing element of the sensor. Minimum immersion depth of the standard is 4.0 inches to minimize stem conduction error.

d) Connect the leadwires from the reference standard (except LHe and Ice point calibrations) and the test sensor through the switch box to the commutating bridge. Adjust the bath to within the desired calibration temperature and allow time for stabilization as indicated by repeated null readings on the galvanometer at one bridge setting. Measure the resistance of the reference standard and record (if applicable).

e) Position the switch on the switch box to measure the resistance of the sensor under test. Measure and record the resistance of the sensor after compensating for lead resistance and bridge error.

f) To ensure no shift in the bath temperature has occurred, recheck reading of the reference standard (except LHe and Ice point calibrations).

1/ Does not apply to sealed sensor models.

4.5.5 Insulation resistance test. Insulation resistance shall be conducted at room temperature with dry external surfaces. The device shall be placed on a flat conductive surface with 100 vdc applied for 2 minutes between the leads and the conductive surface.

4.5.6 Burn-in test. The devices shall be placed in an oven at +100 ±5°C for 168 ±8 hours. The power applied shall be 15 milliwatts.

4.6 Screening inspection. All parts shall be subjected to 100 percent screening inspection in the sequence shown in Table I of this document. The parts shall meet the acceptance criteria specified herein and the detail drawing.

4.6.1 Part disposition. Devices that are out of resistance tolerance, or which experience a change in resistance greater than that permitted for the test conducted

shall be removed from the lot. Lots having more than 10 percent total rejects due to exceeding the specified requirements shall not be furnished on contracts. Except that for lots of ten (10) devices or less, one (1) failure is allowed.

4.7 Damage to parts. Compliance with this specification does not relieve the test agency of the responsibility for parts damaged during testing.

4.8 Problem notification. The test agency shall notify the JPL Technical Representative within twenty-four hours of the occurrence of any of the following:

a) Any catastrophic failure.

b) The number of non-conforming parts exceeds 10 percent of the lot.

c) The number of non-conforming parts after subsequent testing exceeds a cumulative total of 10 percent of the lot.

d) Delays or problems encountered in the course of testing which will impact schedule.

4.9 Data reporting. A copy of the following data, as applicable, shall be supplied:

a) Attributes data for all screening inspections.

b) Final electrical parameters data .

c) Calibration data at temperatures defined in the detail drawing.

4.9.1 Data report format. Data shall be identified by part type, lot number and serial number range. The required electrical data and delta analysis shall be presented in easily readable condition and in serial number order, such that all data for a particular temperature is grouped together and in test sequence order.

4.9.2 Magnetic media. Variables data and delta calculations may be supplied on a magnetic media in computer readable format, provided the format is approved by the procuring activity.

5. PACKAGING

5.1 Unit packaging requirements. The devices shall be packaged in clear plastic boxes, using styrofoam separators to protect the part case and leads during shipment. Each box shall contain only one device and shall be clearly identified with the part name, part style, manufacturer, and serial number.

5.2 Packaging in shipping containers. The requirements for packaging and shipping shall be in accordance with MIL-R-39032.

6. NOTES

6.1 Certificate of conformance. Certificate of conformance to this specification, signed by an authorized representative of the manufacturer, must accompany each shipment.

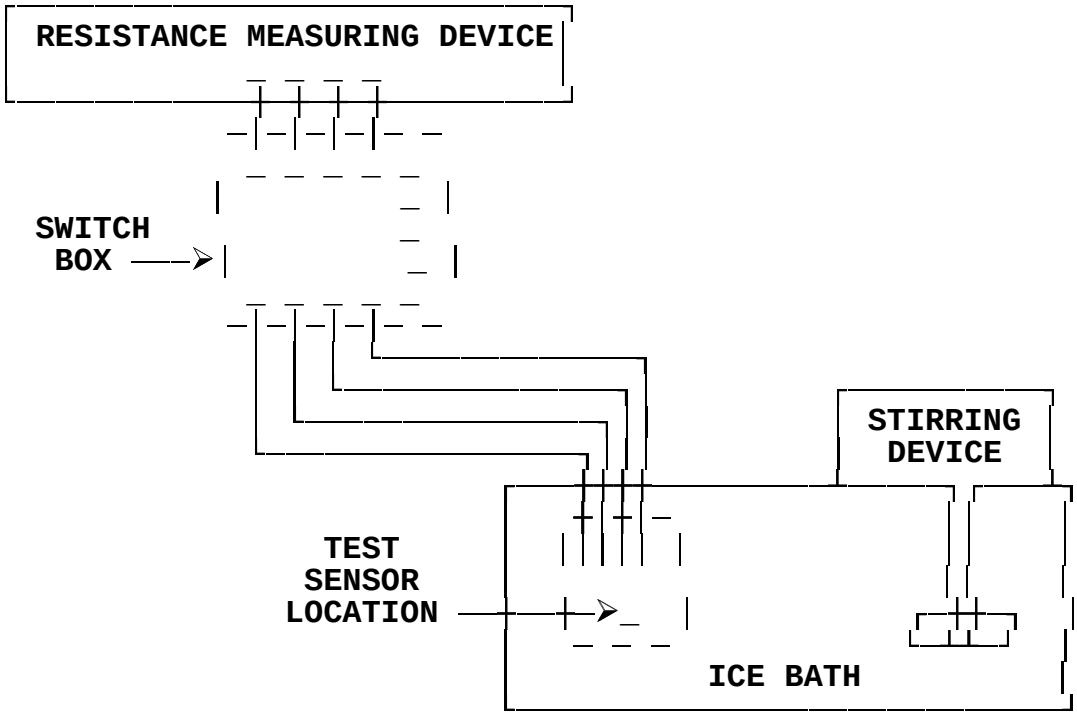
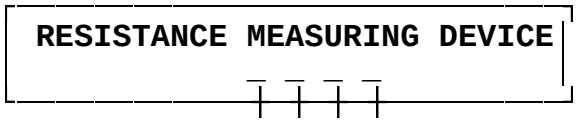


Figure 1. Ice bath calibration diagram.



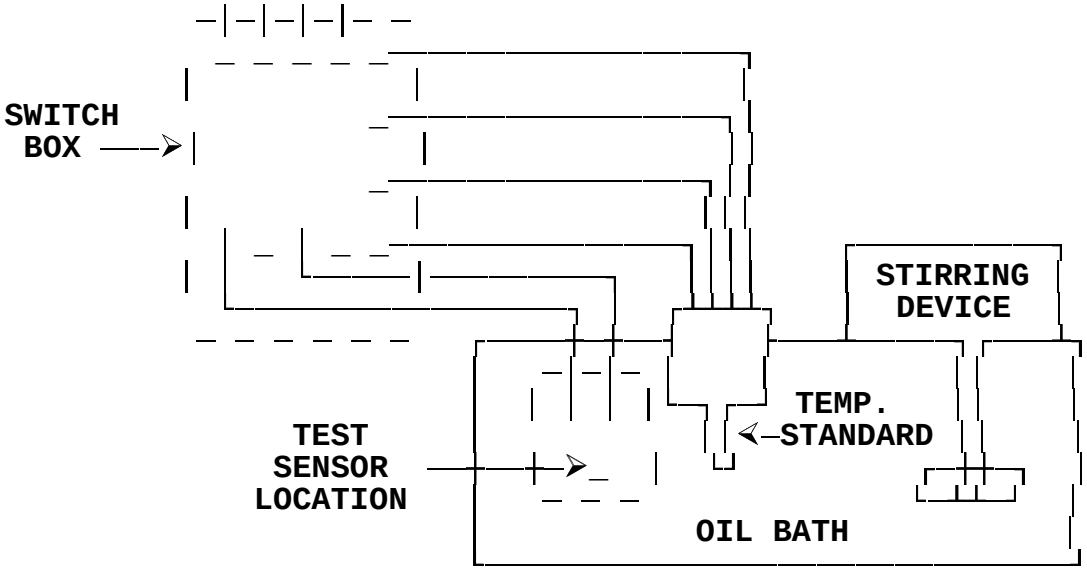


Figure 2. Oil bath calibration diagram.

Table I. Screening Inspection

INSPECTION/TEST	CS506099 REQUIREMENT	METHOD PARAGRAPH	ALLOWABLE CHANGE	SAMPLE SIZE
THERMAL SHOCK	3.6.5	4.5.4	±0.1°C	100%
BURN-IN	3.6.7	4.5.7	±0.1 %	
INSULATION RESISTANCE	3.6.6	4.5.6	100 Meg. Min.	
VISUAL EXAMINATION	3.6.2	4.5.1	Detail dwg.	
RESISTANCE TEMP. CHARA.	3.4.5	4.5.5	- -	
0°C CALIBRATION RESISTANCE	3.6.4	4.5.3	Detail dwg.	

TABLE II CALIBRATION

CAL. SCH.	TEMPERATURE RANGE °C	CALIBRATION POINTS °C	CALIBRATION ACCURACY °C	POINTS/INCREMENTS REQUIRED IN CALCULATED R vs T TABLE
A	-180 to +500	-183 (LO2) 0 (ICE POINT)	±.015 ±.016	69 Points from -180 to

		+100 (OIL BATH) +260 (OIL BATH)	±.041 ±.061	+500°C in 10°C increments.
B	-260 to 0	-269 (LHe) -196 (LN2) 0 (ICE POINT)	±.03 ±.016 ±.016	44 Points from -260 to +251°C in 1°C increments. From -250 to 0°C in 10° increments.
C	-260 to +500	-269 (LHe) -196 (LN2) 0 (ICE POINT) +100 (OIL BATH) +260 (OIL BATH)	±.10 ±.016 ±.016 ±.041 ±.061	94 Points from -260 to -251°C in 1°C increments. From -250 to -175°C in 5°C increments. From -170 to +500°C in 10°C increments.
D	0 to +200	0 (ICE POINT) +100 (OIL BATH)	±.016 ±.041	21 points from 0 to +200°C in 10°C increments.
E	0 to +500	0 (ICE POINT) +100 (OIL BATH) +260 (OIL BATH)	±.016 ±.041 ±.061	51 Points from 0 to +500°C in 10°C increments.
F	0 to +800	0 (ICE POINT) +200 (OIL BATH) +370 (OIL BATH)	±.016 ±.070 ±.087	41 Points from 0 to +800°C in 10°C increments.
G	0 to +660	0 (ICE POINT) +370 (OIL BATH) +660 (FURNACE)	±.016 ±.087 ±.250	34 Points from 0 to +660°C in 20°C increments.

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